

dnsop
Internet-Draft
Obsoletes: [6944](#) (if approved)
Intended status: Standards Track
Expires: April 14, 2017

P. Wouters
Red Hat
O. Sury
CZ.NIC
October 11, 2016

Algorithm Implementation Requirements and Usage Guidance for DNSSEC
draft-wouters-sury-dnsop-algorithm-update-02

Abstract

The DNSSEC protocol makes use of various cryptographic algorithms in order to provide authentication of DNS data and proof of non-existence. To ensure interoperability between DNS resolvers and DNS authoritative servers, it is necessary to specify a set of algorithm implementation requirements and usage guidance to ensure that there is at least one algorithm that all implementations support. This document defines the current algorithm implementation requirements and usage guidance for DNSSEC. This document obsoletes [RFC-6944](#).

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <http://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on April 14, 2017.

Copyright Notice

Copyright (c) 2016 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect

to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1.	Introduction	2
1.1.	Updating Algorithm Implementation Requirements and Usage Guidance	2
1.2.	Updating Algorithm Requirement Levels	2
1.3.	Document Audience	3
2.	Conventions Used in This Document	4
3.	Algorithm Selection	4
3.1.	DNSKEY Algorithms	4
3.2.	DS and CDS Algorithms	5
4.	Security Considerations	6
5.	Operational Considerations	7
6.	IANA Considerations	7
7.	Acknowledgements	7
8.	References	7
8.1.	Normative References	7
8.2.	Informative References	7
	Authors' Addresses	9

[1.](#) Introduction

The DNSSEC signing algorithms are defined by various RFCs, including [\[RFC4034\]](#), [\[RFC5155\]](#), [\[RFC5702\]](#), [\[RFC5933\]](#), [\[RFC6605\]](#), [\[I-D.ietf-curdle-dnskey-eddsa\]](#). DNSSEC is used to provide authentication of data. To ensure interoperability, a set of "mandatory-to-implement" DNSKEY algorithms are defined. This document obsoletes [\[RFC6944\]](#).

[1.1.](#) Updating Algorithm Implementation Requirements and Usage Guidance

The field of cryptography evolves continuously. New stronger algorithms appear and existing algorithms are found to be less secure than originally thought. Therefore, algorithm implementation requirements and usage guidance need to be updated from time to time to reflect the new reality. The choices for algorithms must be conservative to minimize the risk of algorithm compromise.

[1.2.](#) Updating Algorithm Requirement Levels

The mandatory-to-implement algorithm of tomorrow should already be available in most implementations of DNSSEC by the time it is made mandatory. This document attempts to identify and introduce those

algorithms for future mandatory-to-implement status. There is no guarantee that the algorithms in use today may become mandatory in the future. Published algorithms are continuously subjected to cryptographic attack and may become too weak or could become completely broken before this document is updated.

This document only provides recommendations for the mandatory-to-implement algorithms or algorithms too weak that are recommended not to be implemented. As a result, any algorithm listed at the [\[DNSKEY-IANA\]](#) and [\[DS-IANA\]](#) registries not mentioned in this document MAY be implemented. For clarification and consistency, an algorithm will be set to MAY only when it has been downgraded.

Although this document updates the algorithms to keep the DNSSEC authentication secure over time, it also aims at providing recommendations so that DNSSEC implementations remain interoperable. DNSSEC interoperability is addressed by an incremental introduction or deprecation of algorithms.

It is expected that deprecation of an algorithm is performed gradually. This provides time for various implementations to update their implemented algorithms while remaining interoperable. Unless there are strong security reasons, an algorithm is expected to be downgraded from MUST to MUST- or SHOULD, instead of MUST NOT. Similarly, an algorithm that has not been mentioned as mandatory-to-implement is expected to be introduced with a SHOULD instead of a MUST.

Since the effects of using an unknown DNSKEY algorithm is for the zone to be treated as insecure, it is recommended that algorithms downgraded to SHOULD- or below are no longer used by authoritative nameservers and DNSSEC signers to create new DNSKEY's. This will allow for algorithms to slowly become more unused over time. Once deployment has reached a sufficiently low point these algorithms can finally be marked as MUST NOT so that recursive nameservers can remove support for these algorithms.

Recursive nameservers are encouraged to keep support for all algorithms not marked as MUST NOT.

[1.3.](#) Document Audience

The recommendations of this document mostly target DNSSEC implementers as implementations need to meet both high security expectations as well as high interoperability between various vendors and with different versions. Interoperability requires a smooth move to more secure algorithms. This may differ from a user point of view that may deploy and configure DNSSEC with only the safest algorithm.

On the other hand, comments and recommendations from this document are also expected to be useful for such users.

[2.](#) Conventions Used in This Document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC2119](#)].

We define some additional terms here:

- SHOULD+ This term means the same as SHOULD. However, it is likely that an algorithm marked as SHOULD+ will be promoted at some future time to be a MUST.
- SHOULD- This term means the same as SHOULD. However, an algorithm marked as SHOULD- may be deprecated to a MAY in a future version of this document.
- MUST- This term means the same as MUST. However, it is expected at some point in the near future that this algorithm will no longer be a MUST in a future document. Although its status will be determined at a later time, it is reasonable to expect that if a future revision of a document alters the status of a MUST- algorithm, it will remain at least a SHOULD or a SHOULD-.

[3.](#) Algorithm Selection

[3.1.](#) DNSKEY Algorithms

Recommendations for DNSKEY algorithms [[DNSKEY-IANA](#)]

Number	Mnemonics	DNSSEC Signing	DNSSEC Validation
1	RSAMD5	MUST NOT	MUST NOT
3	DSA	MUST NOT	MUST NOT
5	RSASHA1	MUST-	MUST-
6	DSA-NSEC3-SHA1	MUST NOT	MUST NOT
7	RSASHA1-NSEC3-SHA1	MUST-	MUST-
8	RSASHA256	MUST	MUST
10	RSASHA512	SHOULD-	MUST
12	ECC-GOST	SHOULD NOT	SHOULD-
13	ECDSAP256SHA256	SHOULD-	MUST-
14	ECDSAP384SHA384	SHOULD NOT	SHOULD-
TBD	ED25519	SHOULD+	SHOULD+
TBD	ED448	SHOULD+	SHOULD+

RSAMD5 is not widely deployed and there is an industry-wide trend to deprecate MD5 usage.

RSASHA1 and RSASHA1-NSEC3-SHA1 are widely deployed, although zones deploying it are recommended to switch to RSASHA256 as there is an industry-wide trend to deprecate SHA1 usage. RSASHA1 does not support NSEC3. RSASHA1-NSEC3-SHA1 can be used with or without NSEC3.

DSA and DSA-NSEC3-SHA1 are not widely deployed and vulnerable to private key compromise when generating signatures using a weak or compromised random number generator.

RSASHA512 is at the SHOULD level for DNSSEC Signing because it has not seen wide deployment, but there are some deployments hence DNSSEC Validation MUST implement RSASHA512 to ensure interoperability.

ECC-GOST is at the SHOULD NOT level because it has not seen wide deployment and the algorithm has not seen wide scrutiny in the crypto community.

ECDSAP256SHA256 and ECDSAP384SHA384 provide more strength for signature size than RSASHA256 and RSASHA512 variants.

ECDSAP256SHA256 has seen increased deployment and has been raised to MUST- level for resolving and SHOULD- for signing. It is seen as a temporary improvement over RSA until the [\[I-D.ietf-curdle-dnskey-eddsa\]](#) algorithms are published, implemented and deployed. ECDSAP384SHA384 offers little over ECDSAP256SHA256 and has not seen wide deployment, so the use is discouraged, especially for signing.

ED25519 and ED448 uses Edwards-curve Digital Security Algorithm (EdDSA). There are three main advantages of the EdDSA algorithm: It does not require the use of a unique random number for each signature, there are no padding or truncation issues as with ECDSA, and it is more resilient to side-channel attacks. Hence it is expected that these algorithms will be raised to SHOULD for signing and MUST for resolving once it has seen more implementations and deployment.

[3.2.](#) DS and CDS Algorithms

Recommendations for Delegation Signer Digest Algorithms [\[DNSKEY-IANA\]](#)
 These also apply to the CDS RRTYPE as specified in [\[RFC7344\]](#)

Number	Mnemonics	DNSSEC Delegation	DNSSEC Validation
0	NULL (CDS only)	MUST NOT [*]	MUST NOT [*]
1	SHA-1	SHOULD NOT	MUST-
2	SHA-256	MUST	MUST
3	GOST R 34.11-94	MAY	SHOULD
4	SHA-384	MAY	SHOULD+

[*] - This is a special type of CDS record signaling removal of DS at the parent in [\[I-D.ietf-dnsop-maintain-ds\]](#)

NULL is a special case, see [\[I-D.ietf-dnsop-maintain-ds\]](#)

SHA-1 is in wide use for DS records, but its use is discouraged as it is an aging algorithm. Users of SHA-1 SHOULD upgrade to SHA-256.

SHA-256 is in wide use and considered strong.

GOST R 34.11-94 is not in wide use. It is still recommended to be supported in validators so that adoption can increase.

SHA-384 is not in wide use. It is still recommended to be supported in validators so that adoption can increase.

4. Security Considerations

The security of cryptographic-based systems depends on both the strength of the cryptographic algorithms chosen and the strength of the keys used with those algorithms. The security also depends on the engineering of the protocol used by the system to ensure that there are no non-cryptographic ways to bypass the security of the overall system.

This document concerns itself with the selection of cryptographic algorithms for the use of DNSSEC, specifically with the selection of "mandatory-to-implement" algorithms. The algorithms identified in this document as "MUST implement" or "SHOULD implement" are not known to be broken at the current time, and cryptographic research so far leads us to believe that they will likely remain secure into the foreseeable future. However, this isn't necessarily forever and it is expected that new revisions of this document will be issued from time to time to reflect the current best practice in this area.

Retiring an algorithm too soon would result in a signed zone with such an algorithm to be downgraded to the equivalent of an unsigned

zone. Therefore, algorithm deprecation must be done very slowly and only after careful consideration and measurements of its use.

5. Operational Considerations

DNSKEY algorithm rollover in a live zone is a complex process. See [\[RFC6781\]](#) and [\[RFC7583\]](#) for guidelines on how to perform algorithm rollovers.

6. IANA Considerations

This document makes no requests of IANA.

7. Acknowledgements

This document borrows text from [RFC 4307](#) by Jeffrey I. Schiller of the Massachusetts Institute of Technology (MIT) and the 4307bis document by Yoav Nir, Tero Kivinen, Paul Wouters and Daniel Migault. Much of the original text has been copied verbatim.

We wish to thank Olafur Gudmundsson and Paul Hoffman for their imminent feedback.

8. References

8.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997, <<http://www.rfc-editor.org/info/rfc2119>>.

8.2. Informative References

[RFC4034] Arends, R., Austein, R., Larson, M., Massey, D., and S. Rose, "Resource Records for the DNS Security Extensions", [RFC 4034](#), DOI 10.17487/RFC4034, March 2005, <<http://www.rfc-editor.org/info/rfc4034>>.

[RFC5155] Laurie, B., Sisson, G., Arends, R., and D. Blacka, "DNS Security (DNSSEC) Hashed Authenticated Denial of Existence", [RFC 5155](#), DOI 10.17487/RFC5155, March 2008, <<http://www.rfc-editor.org/info/rfc5155>>.

[RFC5702] Jansen, J., "Use of SHA-2 Algorithms with RSA in DNSKEY and RRSIG Resource Records for DNSSEC", [RFC 5702](#), DOI 10.17487/RFC5702, October 2009, <<http://www.rfc-editor.org/info/rfc5702>>.

GOST Signature Algorithms in DNSKEY and RRSIG Resource Records for DNSSEC", [RFC 5933](#), DOI 10.17487/RFC5933, July 2010, <<http://www.rfc-editor.org/info/rfc5933>>.

- [RFC6605] Hoffman, P. and W. Wijngaards, "Elliptic Curve Digital Signature Algorithm (DSA) for DNSSEC", [RFC 6605](#), DOI 10.17487/RFC6605, April 2012, <<http://www.rfc-editor.org/info/rfc6605>>.
- [RFC6781] Kolkman, O., Mekking, W., and R. Gieben, "DNSSEC Operational Practices, Version 2", [RFC 6781](#), DOI 10.17487/RFC6781, December 2012, <<http://www.rfc-editor.org/info/rfc6781>>.
- [RFC6944] Rose, S., "Applicability Statement: DNS Security (DNSSEC) DNSKEY Algorithm Implementation Status", [RFC 6944](#), DOI 10.17487/RFC6944, April 2013, <<http://www.rfc-editor.org/info/rfc6944>>.
- [RFC7344] Kumari, W., Gudmundsson, O., and G. Barwood, "Automating DNSSEC Delegation Trust Maintenance", [RFC 7344](#), DOI 10.17487/RFC7344, September 2014, <<http://www.rfc-editor.org/info/rfc7344>>.
- [RFC7583] Morris, S., Ihren, J., Dickinson, J., and W. Mekking, "DNSSEC Key Rollover Timing Considerations", [RFC 7583](#), DOI 10.17487/RFC7583, October 2015, <<http://www.rfc-editor.org/info/rfc7583>>.
- [I-D.ietf-curdle-dnskey-eddsa]
Sury, O. and R. Edmonds, "EdDSA for DNSSEC", [draft-ietf-curdle-dnskey-eddsa-01](#) (work in progress), October 2016.
- [I-D.ietf-dnsop-maintain-ds]
Gudmundsson, O. and P. Wouters, "Managing DS records from parent via CDS/CDNSKEY", [draft-ietf-dnsop-maintain-ds-03](#) (work in progress), June 2016.
- [DNSKEY-IANA]
"DNSKEY Algorithms", <<http://www.iana.org/assignments/dns-sec-alg-numbers/dns-sec-alg-numbers.xhtml>>.
- [DS-IANA]
"Delegation Signer Digest Algorithms", <<http://www.iana.org/assignments/ds-rr-types/ds-rr-types.xhtml>>.

Authors' Addresses

Paul Wouters
Red Hat

E-Mail: pwouters@redhat.com

Ondrej Sury
CZ.NIC

E-Mail: ondrej.sury@nic.cz

